Actionable Science for Communities

ORD Technical Support and EPA Regions: Successful Partnerships in Cleaning Up Communities

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Bringing Innovations to Site Characterization

- Characterizing subsurface conditions is critical for successful site restoration. By applying the latest science through innovative site characterization technologies, a scale-appropriate understanding of contaminant distribution can be generated for a site and be the foundation for the site's remedial strategy.
- Examples of ORD specialized technical support and applied research include:
  - Analytics (e.g., tentatively identified compounds [TICs], x-ray fluorescence [XRF], bioavailability)
  - Emerging contaminants (e.g., PFAS, RDX, DNT, 1,4-dioxane)
  - Isotopes (e.g., forensics, geochronology)
  - Contaminant Delineation (e.g., groundwater to surface water intersection, passive samplers, mass flux, LNAPL and DNAPL)

Addressed Program and Regional Office Need:

Tools (e.g., data analysis and decision support) for identifying sources of vapor intrusion

Featured Project: **Oak Grove Village Well Site**

- Objective
  - To determine the source of contaminants at a site that consists of highly complex karst geology with potential of multiple chlorinated solvent contaminant sources (Figure 1)
- Accomplishments
  - Applied compound specific isotope analysis (CSIA) to locate and "Fingerprint" source of contaminants
  - Illustrates combined work of ETSC, SCMTSC, and OSRTI to further applied science
- Benefits to ORD and partners
  - Aid EPA in recuperating a portion of cleanup cost from responsible parties that released contaminants
- Future directions
  - Evaluating potential vapor intrusion in associated underground caverns

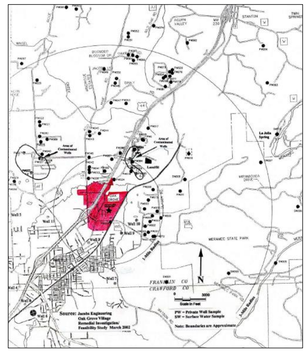

Figure 1: Oak Grove Village and Other Areas with TCE-Contaminated Water

Improving Conceptual Site Models

- The Conceptual Site Model (CSM) is an iterative, *living representation* of a site that summarizes and helps project teams visualize and understand available information. Development and evolution of a CSM can address the unique needs of each stage in a project's life cycle and provide a valuable tool for successful environmental cleanup.
- Examples of specialized technical support provided include:
  - Fate and transport assessment (e.g., matrix diffusion, fractured rock, karst geology)
  - Modeling (e.g., 3-D CSM, groundwater, watershed, basin)
  - Exposure pathway assessment (vapor intrusion, ecological toxicity)

Addressed Program and Regional Office Need:

Improving understanding of exposure pathways for PCBs, PAHs, dioxins, Hg/Me-Hg, and metals into sediment and fish tissue

Featured Project: **Black Butte Mine Superfund Site**

- Objective: To identify the role of ongoing water level fluctuations on MeHg production within the sediment at Cottage Grove Reservoir
- Accomplishments – Determined the following
  - Water-level fluctuations increase methylation (related to sulfate re-cycling) (Figure 2)
  - Hg methylation has high spatial variability within a reservoir
  - Inorganic Hg in the most highly contaminated sediments appears to be less available for methylation
- Benefits to ORD and partners
  - Addressed data gap by identifying variables controlling Hg speciation
  - Accelerated the Region's ability to better understand options for reducing MeHg levels in fish
  - Knowledge gained applicable within Region 10 and nationally
- Future directions
  - Evaluating remedial options to control ongoing sources of mercury to surface water

High Pool Area at Cottage Grove Reservoir

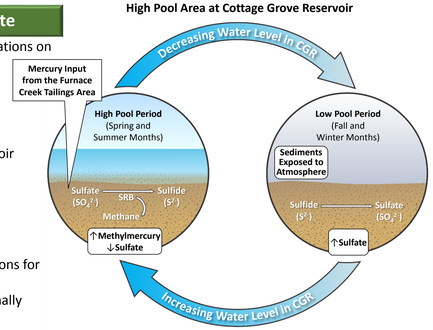

Figure 2: Diagram Showing the Influence of Water Level Fluctuation on Sulfate Recycling and the Affect on MeHg Production

Advising and Optimizing Remedy Selection

- Independent remedy evaluation during the Feasibility Study, remedy selection and design, and pilot studies is paramount to improve remedial strategies and ensure remedial goals are achieved.
- Overview of ORD Specialized Technical Support and Applied Research
  - Remedy effectiveness and design (e.g., in situ chemical oxidation [ISCO], bioremediation, monitored natural attenuation [MNA]), greener cleanups)
  - Alternative technology options (e.g., surface water treatment processes, sediment and sludge stabilization, reactive caps)
  - Innovative technology research (PFAS and perchlorate treatment, remediation in fractured rock, performance monitoring with isotopes)
  - Optimization (aging systems [slurry walls], monitoring plans)
  - Team Building with Stakeholders (integrating public comments into remedy selection)

Addressed Program and Regional Office Need:

Developing innovative technologies for treating mining influenced water (MIW)

Featured Project: **Formosa Mine**

- Objective
  - To evaluate use of biochar and biosolids soil amendments to assist plant regrowth and metals stabilization
- Accomplishments to date
  - Establishing a stabilizing native plant cover limits exposure pathways and movement of contaminants
  - Developing methods to make biochar (Figure 3)
  - Developing methods to monitor the progress of site recovery
- Benefits to ORD and partners
  - Applied science from Region 4 used in use Region 7 and 10
  - Research results will support remedial design options
  - Local communities fully support work of EPA team and appreciate potential for beneficial reuse of materials
- Future directions
  - Integrating Biochar applied research findings into the site remedial design

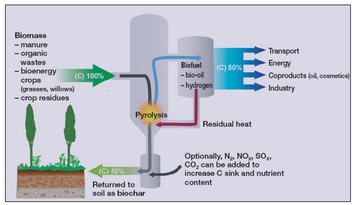

Figure 3: Biochar from Pyrolysis

Facilitating Specialized Engineering Support

- Specialized engineering support entails providing design specifications, contributing scope elements, and performing engineering analyses. When this support is requested, often only a hand full of individuals in the industry can perform the work.
- Overview of ORD Specialized Technical Support and Applied Research
  - Interpretation of bench scale results (in situ thermal, ISCO oxidant selection)
  - Design and implementation of remedies (in situ thermal, soil-mixing for ISCO, subaqueous and surface reactive caps, soil vapor extraction system
  - Ancillary engineering analyses (landfill subsidence, evapotranspiration cap design, sludge lagoon cap, erosion control)

Addressed Program and Regional Office Need:

Optimization of remedial actions and engineering through use of specialized expertise

Featured Project: **Argonaut Mine**

- Objective
  - To perform debris flow modeling for potential dam failure
- Accomplishments to date
  - Established three conditions (dry, average and wet flow) and the impact of a levee breach under each condition
  - Determined a dam failure would impact downstream human and environmental resources
  - Produced inundation maps (Figure 4) and total loss tables
- Benefits to ORD and partners
  - Joint effort between ORD, USGS, and US Army Corps which resulted in the site being listed in the NPL
  - EPA RPM presented at public meeting with goal to add Argonaut Dam to list of priorities in city's Hazard Mitigation Plan
- Future directions
  - Due to this modeling work, petitioned for listing as Superfund site, which happened in 2016

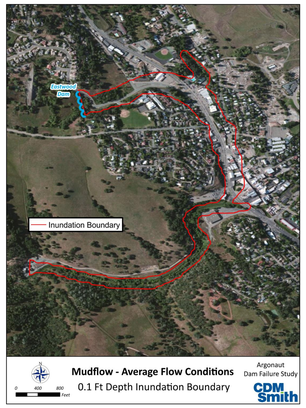

Figure 4: Inundation Boundary, Argonaut Dam Failure Study

Providing Statistical Analyses and Support

- The cleanup process is complex, requiring technical assistance to address statistical issues associated with the various polluted site projects. Establishing and implementing appropriate cleanup plans is a long-term process that involves a team of decision makers from across EPA and external stakeholders.
- Overview of ORD Specialized Technical Support and Applied Research
  - Large-scale data compilation from literature and site databases
  - Robust statistical analyses (background levels, trends, geochemical evaluations)
  - Statistical Tool (ProUCL development, enhancement, and use)
  - Sampling Plans (incremental sampling methodology, sample size, reference area determination)

Addressed Program and Regional Office Need:

Developing statistical methodology for sampling based on scientifically defensible site characterization techniques

Featured Project: **West Lake Landfill Site**

- Objective
  - To identify boundary of radiologically impacted material (RIM) with certain confidence coefficient (CC)
- Accomplishments to date
  - Developed statistical sampling plan to determine areas where RIM is present at levels above risk-based cleanup levels (Figure 5)
  - Determined locations of new sampling locations in Areas 1 and 2 at site
  - Used geostatiscal methods to estimate RIM and delineate RIM boundary with desired CC as part of on-going review
- Benefits to ORD and partners
  - Used ProUCL (an EPA developed statistical tool) to verify CC
  - For Area 1, one sampling location had already been sampled in parallel investigation, demonstrating validity of review
- Future directions
  - Support completed

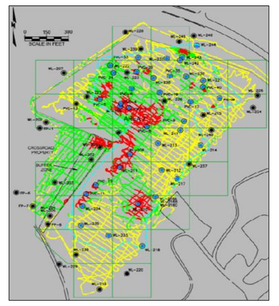

Figure 5: RAD Data Collected Using a Grid Pattern

Developing and Applying Decision-Support Tools

- Remedy decisions are complex and require input from a wide audience of stakeholders. Decision-support tools help the site RPM to capture all of the factors that need to be considered when developing a Superfund remedial action approach that will result in protection of human health and the environment.
- Overview of ORD Technical Support and Applied Research
  - Structured decision making (e.g., wood waste management, cleanup model on watershed basis, nitrogen cycling)
  - Life-cycle analyses (e.g., footprint analyses, inventory data for materials and activities at cleanup sites)

Addressed Program and Regional Office Need:

Understanding uncertainty and communicating project outcomes to community stakeholders

Featured Project: **Bunker Hill Superfund Site**

- Objectives
  - To optimize remedial actions through the use of the Analysis for a Sustainable Environment, Economy, and Society (DASEES) tool (Figure 6)
  - To evaluate how DASEES can enhance community engagement
  - To utilize DASEES in developing sustainable remediation solutions
- Benefits to ORD and partners
  - Results will provide information how DASEES can be used more effectively within the Superfund regulations for selecting and implementing actions to protect human health and the environment
  - Results will indicate whether using a decision-support tool assists with community engagement
- Future directions
  - Due to the complex nature of the Superfund sites that still require remedial action, the use of DASEES and adaptive site management (ASM) could become important tools to facilitate site cleanup

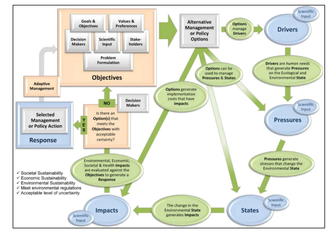

Figure 6: Decision Support Framework (DSF) Conceptual Model

SUSTAINABLE & HEALTHY COMMUNITIES RESEARCH PROGRAM